U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Linum arenicola* (Small) H.J.P. Winkler

COMMON NAME: Sand flax

LEAD REGION: 4

INFORMATION CURRENT AS OF: October 2005

STATUS/ACTION:
___ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status
___ New candidate
_X__ Continuing candidate
___ Non-petitioned
_X_ Petitioned - Date petition received: May 11, 2004
__ 90-day positive - FR date:
__ 12-month warranted but precluded - FR date:
__ Did the petition request a reclassification of a listed species?
FOR PETITIONED CANDIDATE SPECIES:
a. Is listing warranted (if yes, see summary of threats below)? _yes
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? _yes
c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions (including candidate species with lower LPNs). During the past 12 months, almost our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations, and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov/).
___ Listing priority change
Former LP: ___

New LP: ___

Date when the species first became a Candidate (as currently defined): October 25, 1999

___ Candidate removal: Former LP: ___

___ A – Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

___ F – Range is no longer a U.S. territory.

___ I – Insufficient information exists on biological vulnerability and threats to support listing.

___ M – Taxon mistakenly included in past notice of review.

___ N – Taxon does not meet the Act's definition of "species."

___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Flowering plants, Linaceae, Flax Family

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Florida, U.S.A.

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Florida, Miami-Dade and Monroe Counties, U.S.A.

LAND OWNERSHIP

The only relatively large population (over 1,000 plants) is on the National Key Deer Refuge (U.S. Fish and Wildlife Service) and Terrestris Preserve (The Nature Conservancy). Other smaller populations are owned or managed by the Florida Fish and Wildlife Conservation Commission (Florida Keys Wildlife and Environmental Area tracts at Sugarloaf Hammocks and Big Torch Key), Miami-Dade Parks (Camp Owaissa Bauer, Homestead Bayfront Park, and the Luis Martinez Army Reserve Station), and the Florida Department of Transportation (adjoining Sugarloaf Hammocks). One small population is on a private preserve in Miami-Dade County, and part of one population is on private land near Camp Owaissa Bauer.

LEAD REGION CONTACT: Richard Gooch, 404-679-7217

LEAD FIELD OFFICE CONTACT: South Florida Ecological Services Office, David Martin, 772-562-3909 ext. 230

BIOLOGICAL INFORMATION

Species Description: *Linum arenicola* is a wiry, yellow-flowered perennial herb with one to several stems from its base, linear leaves 7-10 millimeters (mm) long, and flowers with yellow petals about 4.5-5.5 mm long (Bradley and Gann 1999, adapted from Rogers 1963). "*L. arenicola* is a glabrous perennial herb; stems 1-several from the base, wiry, 35-53 cm tall; leaves mostly alternate, linear, 7-10 mm long, 0.601 mm wide, entire or with scattered marginal glands;

stipules glandular, reddish; inflorescence a cyme of a few slender, spreading or ascending branches; pedicels 2 mm long or less; sepals lanceolate to ovate with a prominent midrib, 42.4-3.2 mm long; petals yellow, obovate, 4.5-5.5 mm long; fruit 2.1-2.5 mm diameter, pyriform, dehiscing into ten segments; seeds ovate, 1.2-1.4 mm long, 0.7-0.8 mm wide." (Bradley and Gann 1999, adapted from Rogers 1963).

Taxonomy: "This species was first described by [John Kunkel] Small in 1907 as *Cathartolinum arenicola* for plants he collected in Miami-Dade County in 1904. This treatment was consistently followed by Small (1913a, 1913b, 1933). In 1931, Winkler include *Cathartolinum* within the genus *Linum*, renaming the plants *Linum arenicola*. Others have followed this treatment, including Rogers (1963), Long and Lakela (1971), Robertson (1971), and Wunderlin (1998)." (Bradley and Gann 1999).

Habitat: "*L. arenicola* is found in pine rockland, marl prairie, and disturbed areas. It grows on oolitic limestone formations. The pine rockland and marl prairie where this species occurs requires periodic . . . fires in order to maintain an open, shrub-free subcanopy and reduce litter levels. This taxon is currently rare in relatively undisturbed natural areas, with the exception of plants on Big Pine Key and the [grounds of an office building on Old Cutler Road]. Several occurrences are in scarified pine rockland fragments that are dominated by native pine rockland species, but have little or no canopy or subcanopy. One population in Miami-Dade County occurs entirely on a levee composed of crushed oolitic limestone in the middle of a sawgrass marsh." (Bradley and Gann 1999).

Historical Range/Distribution: Sand flax historically was distributed in Monroe County in the lower Florida Keys, and in central and southern Miami-Dade County. In Miami-Dade, the plant was widespread from Coconut Grove to what is now the main entrance to Everglades National Park and Turkey Point. In Monroe County, the plant was recorded from Big Pine Key, Ramrod Key, Sugarloaf Key, Park Key, Boca Chica Key, and Middle Torch Key (Bradley and Gann 1999). This plant was reported from the Homestead Air Reserve Base by Kernan and Bradley (1996).

Kernan and Bradley (1996) reported six mainland (Miami-Dade County) stations for *L. arenicola*. They estimated that approximately 1,000 plants occurred in Miami-Dade County, with about 600 at Homestead Air Reserve Base (we have no recent information on this property). A population they called Old Cutler contained 26 percent of the known individuals in Miami-Dade County, prior to being cleared (Bradley and Gann 1999). As of 1996, there were fewer than 200 plants in the remaining populations on the mainland (Kernan and Bradley 1996).

Ross and Ruiz (1996) found *L. arenicola* in 16 of 145 plots in five pine rockland vegetation sampling transects at the National Key Deer Refuge on Big Pine Key. They provided no estimates of numerical abundance. No plants were found at other pine rockland vegetation sampling sites elsewhere in the Florida Keys.

Current Range/Distribution: *Linum arenicola* is currently known from the following sites in Miami-Dade County: Camp Owaissa Bauer (owned by Miami-Dade County) and adjoining private land (Gann et al. 2002), the Luis Martinez U.S. Army Reserve Station Richmond Pine Rocklands (managed by Miami-Dade County) (The Institute for Regional Conservation 2004), and Homestead Bayfront Park (on a limestone canal levee). A small colony exists along a roadway at a pine rockland fragment owned by The Institute for Regional Conservation on the east side of 125 Avenue, south of 236 Street, and on the banks of the adjacent canal. A population on Bauer Drive adjacent to the Camp Owaissa Bauer Archery Range and Country Ridge Estates has not been observed in several years. It may have become extirpated due to herbicide usage and vegetation succession on scarified land.

In Monroe County, *Linum arenicola* occurs on Big Pine Key (in part on the National Key Deer Refuge and also on the Terrestris Preserve, owned by The Nature Conservancy). It is in the Sugarloaf hammocks of Florida Keys Wildlife and Environmental Area on Sugarloaf Key, operated by the Florida Fish and Wildlife Conservation Commission (Gann et al. 2002, Institute for Regional Conservation 2004). The Sugarloaf site extends onto right-of-way managed by the Florida Department of Transportation (Bradley and Gann 1999). It is also reported from two parcels on Big Torch Key belonging to the Florida Keys Wildlife and Environmental Area (Gann et al.2002). This totals 4 sites in Miami-Dade County (1 private, 3 public or part-public) and 3 sites in the Keys (counting the two Big Pine Key ownerships as a single large site and sites on Big Torch Key as a single site). Early results of a survey currently underway found populations on Lower Sugarloaf, Big Torch and Middle Torch Keys. This includes a new locality on Lower Sugarloaf (Hodges and Bradley 2005).

This plant's propensity to persist in disturbed areas makes a full inventory of populations difficult (Bradley and Gann 1999). The plant could still be present on Ramrod, Middle Torch, and Boca Chica Keys, which have not been recently surveyed. During the summer of 2005, Hodges and Bradley (2005) initiated population surveys for *L. arenicola* on Big Pine Key as well surveys for occurrences in other likely Keys. The Big Pine Key survey area includes Monroe County and State owned parcels as well as the National Key Deer Refuge. This project will provide the first comprehensive survey of distribution and abundance for the area.

Population Estimates/Status: "The estimated total population of *L. arenicola* is 10,001 to 100,000 plants. The total population is probably closer to 10,000 plants, with 1,000 to 3,000 occurring in completely artificial environments. Many of these plants are not in natural areas, occurring on roadsides or other artificial conditions. Only two occurrences . . . [are] in natural areas, on Big Pine Key and [on the grounds of an office building on Old Cutler Road]." (Bradley and Gann 1999). The only population known to exceed 1,000 plants is on Big Pine Key, which Bradley and Gann (1999) estimate at between 1,001 and 10,000 plants.

THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range. Residential and commercial development has drastically reduced the habitat for *Linum*

arenicola in pine rocklands of south Florida and the Florida Keys. Pine rockland habitat in Miami-Dade County has been reduced to about 11 percent of its natural extent (Kernan and Bradley 1996). Of the original 74,000 hectares (ha) (182,780 acres) of pine rockland habitat, 8,140 ha (20,106 acres) remained in 1996. Less than 2 percent of the 65,000 ha (160,550 acres) of pine rockland habitat that existed outside Everglades National Park in 1900 remains today (Kernan and Bradley 1996).

Acreage of pine rocklands on Big Pine Key was reduced from 1,049 ha (2,592 acres) in 1955, to 701 ha (1,732 acres) by 1989 (Folk 1991). This resulted in a loss of approximately 33 percent of habitat. Land acquisition for National Key Deer Refuge and other conservation lands on Big Pine Key is ongoing, although some pine rockland habitat remains subject to development on Big Pine Key. A Habitat Conservation Plan for the endangered Key deer on Big Pine and No Name Keys is under development. When finalized, it may also benefit the endemic plants of Big Pine Key, including *Linum arenicola*. Prospects for *L. arenicola* on Big Pine Key may be limited mostly by the relatively small population size.

In Miami-Dade County, *L. arenicola* populations are on preserves and protected from urban development at Camp Owaissa Bauer, Homestead Bayfront Park, and the Luis Martinez U.S. Army Reserve Station Richmond Pine Rocklands (whose management has been transferred to Miami-Dade County), plus a private preserve. The small sizes of these populations, the presence of one on artificial substrate, and the ongoing hazard of exotic pest plant invasions and other disturbances suggest that the Miami-Dade County populations are liable to be extirpated.

B. Overutilization for commercial, recreational, scientific, or educational purposes. Not known.

C. Disease or predation. Not known.

D. The inadequacy of existing regulatory mechanisms. The Florida Department of Agriculture and Consumer Services designated sand flax (*Linum arenicola*) as endangered under Chapter 5B-40, Florida Administrative Code. This listing regulates trade in listed plants. The listing provides little or no habitat protection beyond the State's Development of Regional Impact process, which serves to disclose impacts from projects, but provides no regulatory protection for State-listed plants on private lands. Plants with conservation needs are protected on state and local conservation lands primarily by policies of managing agencies, since the listing by the Department of Agriculture and Consumer Services does not extend to other State agencies or to local governments. Local and county ordinances can also promote plant conservation. For example, Miami-Dade County provides landowner incentives to protect and manage natural forest communities and requires permits for their destruction. A Habitat Conservation Plan for Key deer that is under development may provide habitat protection for this species.

E. Other natural or manmade factors affecting its continued existence. Fire is required to maintain the pine rockland community. Under natural conditions, lightning fires typically occurred at 3- to 7-year intervals. With fire suppression, hardwoods eventually invade pine rocklands and shade out understory species like *Linum arenicola*. The National Key Deer Refuge is addressing these problems. For example, in 2003, the Refuge burned a 120-acre site on Big Pine Key that had been unburned for 17 years. For 10 years, The Nature Conservancy's Terrestris Preserve has been conducting relatively frequent, growing-season prescribed fire, experimental mechanical pre-fire fuel treatments, and ongoing monitoring to quantify the effects of these efforts on community structure and rare plants (U.S. Geological Survey 2004). In the remaining fragmented pinelands of Miami-Dade County, natural fires are unlikely to occur, and if they do, will usually be suppressed. The Service is working cooperatively with Florida International University in Miami to determine the proper fire frequencies necessary to maintain the pine rockland community on the Refuge, results are not yet available.

At least 277 taxa of exotic plants are now known to invade pine rocklands in south Florida (U.S. Fish and Wildlife Service 1998). Some of these may compete directly with *L. arenicola* for space and resources, while others have a profound effect on community structure and responses to fire. Brazilian pepper (*Schinus terebinthifolius*) is the most widespread and one of the most invasive species. If left uncontrolled in a pineland where no fires are being conducted, it will form a single-species thicket that almost completely eliminates native vegetation. Earleaf acacia (*Acacia auriculiformis*), natal grass (*Rhynchelytrum repens*), shrub verbena (*Lantana camara*), and tongue tree (*Albizia lebbeck*) are some of the other exotic pests in pine rocklands. Old World climbing fern (*Lygodium microphyllum*) is spreading into Miami-Dade County and may become a serious problem. All of these species affect the characteristics of a fire when it does occur. Fires that once burned fairly cool with mostly pine needle duff for fuel may now burn much hotter and affect the type of community that develops following fire. For instance, a catastrophic fire encourages bracken fern to form thickets, replacing grasses. Therefore, with the presence of exotic species, it is uncertain how fire, even under a managed situation, will affect *L. arenicola*.

There has been a 15 cm rise in sea level over a 70 year period in the vicinity of Big Pine Key (Ross et al. 1994). The pine rockland vegetation in the Keys has undergone a reduction due to sea-level rise (Ross et al. 1994). For example, the pine rockland area on Sugarloaf Key covered 88 ha (217 acres) prior to 1935, and was reduced to 46 ha (114 acres) by 1935 and 30 ha (74 acres) by 1991. The loss of pine rockland vegetation was correlated with elevated ground- and soil water salinity, and loss of upland plant diversity was inferred. In areas affected by sea level rise, communities of halophytic plants replaced pine rockland communities (Ross et al. 1994).

Illegal dumping could damage *L. arenicola* populations. After Hurricane Andrew in 1992, the Bauer Drive site was disturbed by the placement and collection of a pile of clean-up debris that was illegally dumped on a portion of the population (Kernan and

Bradley 1996). Based on the low number of individuals within the species' narrow range, catastrophic events such as hurricanes and tropical storms may negatively affect the species by altering the vegetation composition or water levels.

Only small populations of this plant remain. As a result, threats associated with small population size ensue. These include potential vulnerabilities from environmental (catastrophic hurricanes), demographic (potential episodes of poor reproduction), and genetic (potential inbreeding depression) threats.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

All publicly-owned pinelands in Miami-Dade County (outside of Everglades National Park) have been mapped. Miami-Dade County arranged to manage the Martinez Army Reserve pineland, and is conducting routine maintenance on its conservation lands (prescribed fires, with the participation of the Florida Division of Forestry; exotic pest plant control). National Key Deer Refuge is carrying out a prescribed fire program and exotic pest control, that is expected to benefit this and other pineland plant species. A Habitat Conservation Plan for the Key deer, currently in preparation, may benefit *L. arenicola*.

SUMMARY OF THREATS (including reasons for addition or removal from candidacy, if appropriate)

The primary threat to *Linum arenicola* is loss and modification of its pineland habitat from development, lack of proper management (mainly prescribed fires), and rising sea level, as documented during the twentieth century.

For species that are being removed from candidate status:

___Is the removal based in whole or in part on one or more individual conservation efforts that you determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions (PECE)?

RECOMMENDED CONSERVATION MEASURES

Management and restoration of public lands in the Lower Keys (removal of exotic pest plants and encroaching hardwoods, as well as application of prescribed fire). Regular monitoring and surveys are needed to assess progress.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	**Imminent**	Monotypic genus	1
		Species	**2***
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude: Only small populations of this plant remain. Those on relatively small tracts of conservation land in urban Miami-Dade County are vulnerable to lapses in management, including invasion by exotic pest plants and lack of adequate prescribed fire or suitable substitutes. The two sites in the Keys seem less vulnerable to rapid invasions by exotic pest plants and may require less frequent prescribed fire because the vegetation grows more slowly. We conclude that the magnitude of threats is high.

Imminence: Threats to the four (out of seven) *Linum arenicola* populations that are in urban/agricultural Miami-Dade County are imminent. During the twentieth century, most of this plant's geographic range was converted to farmland or was urbanized. As a result, threats associated with fragmentation and small population size ensued and are difficult to manage. In particular, conducting prescribed fires is difficult in the small pinelands, and invasive exotic plant threats have been difficult to control. The Miami-Dade conservation lands require regular maintenance. A further problem in Miami-Dade is that the Bayfront Park population is located in an artificial environment, which makes planning its management more difficult. Threats to *L. arenicola* in the Keys are already present and the populations are very small (even on the National Key Deer Refuge).

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No. There are no special short-term threats, such as from

unauthorized collecting or Federal projects, that would require immediate listing.

DESCRIPTION OF MONITORING: The Service assisted Miami-Dade County's project to map pine rocklands. This project used the County's geographic information system, and can detect changes in boundaries as new aerial imagery becomes available. Service biologists are in regular contact with public land managers and biologists in Miami-Dade County and the Florida Keys, and follow research at universities and Fairchild Tropical Botanic Garden and are up-to-date on land acquisition and exotic pest plant control efforts.

COORDINATION WITH STATES
Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: none

Indicate which State(s) did not provide any information or comments: Florida

LITERATURE CITED

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APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

D Approve: /s/ Jeffrey M. Fleming 11/16/2005
Acting Regional Director, Fish and Wildlife Service Date

Concur: _____ August 23, 2006
Acting Director, Fish and Wildlife Service Date

Do Not Concur: _____ _____
Director, Fish and Wildlife Service Date

Date of annual review: October 2005

Conducted by: South Florida (Vero Beach) Field Office